

# The first canted front end at SSRF

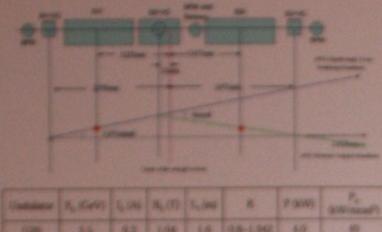
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## Introduction

Protein complex beamline and small-angle X-ray scattering beamline are the first canted beamlines at Shanghai Synchrotron Radiation Facility (SSRF) for NPPS project, which has its respective undulator in the same straight section but shares the same front end. Types of two undulators are both U20, whose parameters and displacements are shown below.

A new canted front end was designed to handle the total power of two undulators, with a beam separation in 6 mradad from a single straight section. As limited by the total length of a front end, the canted beamlines are difficult to have its all independent components as the original ID front end. The most important criterion for a new front end design is that it must conform the SSRF safety rule and be compatible with the existing personnel safety system and equipment protection system. And the other requirement for the canted beamlines is that one of the beamlines shut off will not influence its partner operation. Here, the overall front end layout, new idea design for the key components, such as splitter, photon shutter-fixed mask combination, and thermal analysis for these components are presented.



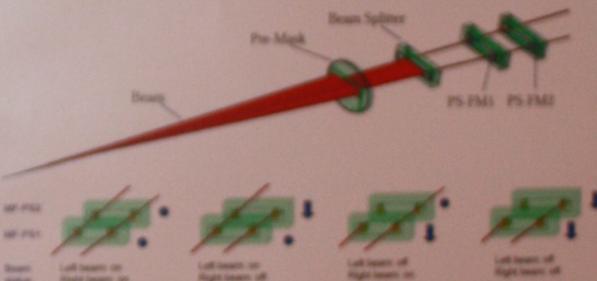
## Main specifications of the canted front end components

	Distance to light source (m)	Beam size	Aperture in H/PV (mm)	Aperture out H/PV (mm)
Valve 1	9.215	105°*12mm	±150	±150
Pre-Mask	9.312	4°*1.mradad	130(72+44)°*24	40(1+24)°*24
Photon Shutter	10.58	92°*8mm	±150	±150
Beam Splitter	11.49	0.6°*0.mradad(1) 0.8°*0.mradad(2)	18°*10	3°*10
Fluorescence Detector	11.41	0.4°*0.mradad(1) 0.2°*0.mradad(2)	±100	±100
Valve 2	12.21	55°*3mm	±100	±100
Fast Valve	12.54	55°*3mm	80°*35	80°*35
XBPMS	12.82	0.4°*0.mradad(1) 0.5°*0.mradad(2)	±150	±150
Photon Shutter-Fixed Mask combination 1 (PS-FM1)	13.37	0.4°*0.mradad(1) 0.5°*0.mradad(2)	14°*200 20°*200(3)	18°*2.300 4°*200(3)
Photon Shutter-Fixed Mask combination 2 (PS-FM2)	14.75	0.4°*0.1.mradad(1) 0.3°*0.1.mradad(2)	20°*200 16°*400(3)	3°*200 18°*2.100
Fast Valve 1	15.58	0.3°*0.1.mradad(1) 0.3°*0.1.mradad(2)	80(12+38)°*14	80°*14
Safe Shutter	16.12	5.3°*2.8mm(1) 4.3°*2.3mm(2)	18°*14	18°*14
Fast Valve 2	16.42	5.8°*3mm(1) 4.3°*2.3mm(2)	80(10+43)°*20 22°*20	24(10+14)°*20 24(14+10)°*20
Valve 3-1	18.0	5.9°*3mm(1)	±40	±40
Valve 3-2	18.1	5.9°*3mm(2)	±40	±40

## Operation of the canted front end

There are four masks in the Canted front end. After the Pre-Mask, a Beam Splitter is used to separate the combined beam from two undulators into two beams, whose exit angles are 0.6°\*0.5mradad(ID1) and 0.8°\*0.8mradad(ID2).

Specially, two movable parts, called Photon Shutter-Fixed Mask combination, can be actuated up and down pneumatically. If the two are both at the up position, two beams will pass through and be used at the same time. When one combination is at the up position and the other is down, one beam can pass through and the other beamline will be shut off. While, if the two are both down, two beams will be stopped and neither beamlines can be used. In conclusion, two beamlines can operate separately by controlling the position of two Photon Shutter-Fixed Mask combinations.



## Finite element analysis of the canted front end components

The canted front end will handle the total power of two undulators. Most components, including Pre-Mask, Photon Shutter, Fluorescence Detector, XBPMS and four masks, are all directly cooled by water. Absorbers of Beam Splitter and two PS-FMs are made of Glidcop. Finite element analysis shows that all components in the canted front end satisfy the failure criteria.



Temperature distributing map of Pre-Mask



Temperature distributing map of Beam Splitter



Temperature distributing map of PS-FM2



Equivalent stress map of Pre-Mask



Equivalent stress map of Beam Splitter



Equivalent stress map of PS-FM2

## Operation status of the canted front end

The canted front end has been successfully designed, constructed and installed at SSRF. All of the key components have achieved a high installation precision of better than  $\pm 0.1\text{mm}$ . Vacuum degree of the whole system is better than  $5 \times 10^{-10}\text{Torr}$ . The completion acceptance of the canted front end has been done in Sep. 2012.

